DISC DRIVE PRINTED CIRCUIT BOARD CONNECTOR LOCATING FEATURE

by

Michael Alan Maiers

and

Robert Terry Haas

Merchant & Gould P.C.
3100 Norwest Center
90 South Seventh Street
Minneapolis, MN 55402-4131

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Cross Reference to Related Applications

This application claims the benefit of U.S. provisional application Serial No. 60/245,963, filed November 3, 2000, entitled "Accurate Low Cost Connector Locating Feature."

Field of the Invention

This application relates to magnetic disc drives and more particularly to a connector locating feature and method for precisely positioning a connector of a printed circuit board relative to the outer dimensions of a disc drive.

Background of the Invention

Disc drives are data storage devices that store digital data in magnetic form on a rotating storage medium on a disc. Modern disc drives comprise one or more rigid discs that are coated with a magnetizable medium and mounted on the hub of a spindle motor for rotation at a constant high speed. Information is stored on the discs in a plurality of concentric circular tracks typically by an array of transducers ("heads") mounted to a radial actuator for movement of the heads relative to the discs. Each of the concentric tracks is generally divided into a plurality of separately addressable data sectors. The read/write transducer, e.g. a magnetoresistive read/write head, is used to transfer data between a desired track and an external environment. During a write operation, data is written onto the disc track and during a read operation the head senses the data previously written on the disc track and transfers the information to the external environment.

Much of the electronics that are essential to the operation of the disc drive are mounted on a printed circuit board assembly ("PCBA") that is typically fastened to a bottom surface or base plate of the disc drive. The PCBA includes electrical components that manage the operations of the disc drive including controlling the speed of the spindle and position of the actuator arms over the discs. Similarly, the PCBA also includes electrical components that interface with the computer's processor.

An electrical connector is typically mounted to the PCBA to provide an electronic hardware interface between the disc drive and the computer. The type of electrical connector

used in a given disc drive is generally dictated by two factors: the size or form factor of the disc drive and the interface specification of the disc drive. The most common interface specification currently used in disc drives is the Advanced Technology Attachment (ATA) interface specification, sometimes referred to as IDE for Integrated Drive Electronics. The ATA specification defines the protocols used to transfer data between ATA compatible devices, such as between a disc drive and a host computer. Other possible interfaces include the Small Computer System Interface ("SCSI") and the recently developed Serial ATA interface.

Current disc drives sizes or "form factors" predominantly fall into two different sizes: the 3.5 inch form factor disc drive and the 2.5 inch form factor disc drive, where the 2.5 inch disc drive is typically used in mobile computing environments such as in laptop computers. The term "form factor" refers to the disc drive industry standard that defines the physical, external dimensions or the "external envelope" of a particular drive.

As noted above, the type of PCBA connector used depends on both the form factor and the drive interface. For example, a 3.5 inch form factor disc drive having a standard ATA connector typically utilizes a 40-pin connector, often referred to as 3-in-1 connector, which is designed to mate with a corresponding female connector. Alternatively, a typical 2.5 inch form factor disc drive employs what is commonly referred to as a 50-pin ATA connector. Furthermore, because 2.5 inch disc drives are typically used in mobile computers, the 50-pin connector on the 2.5 inch drive must typically be plugged into a female connector mounted on a back plane of a drive bay in the mobile computer. Due to the size constraints of a mobile computer (or other environment where a 2.5 inch drive may be utilized), the 2.5 inch disc drive and the corresponding PCBA connector must be precisely located within the computer system so that the pins on the PCBA connector mate precisely with the sockets formed in the corresponding female connector.

Because it is highly desirable to ensure that a disc drive from one manufacturer will fit within a computer system from another manufacturer (i.e., that the pins on the PCBA connector from a first manufacturer will fit within the sockets found in another manufacturer's drive bay), the Small Form Factor ("SFF") Specification has been adopted. The SFF Specification essentially prescribes the location of the PCBA connector relative to the known outer dimension or "external envelope" of a 2.5 inch disc drive. More specifically,

the SFF Specification prescribes the location of a first pin relative to the external envelope of the disc drive. Once the location of the first pin is fixed, the remainder of the pins (which have a known spacing or "pitch") are essentially located relative to the drive envelope so that a PCBA connector of a drive that meets the SFF Specification will fit within a drive bay of a computer system that similarly meets the SFF Specification.

In addition to the SFF Specification, it has become more common for larger disc drives (such as 3.5 inch drives) to also be placed within drive bays. For example, larger computer systems or (e.g., computer servers) are commonly configured with multiple "hot swappable" disc drives where a drive may be pulled from an externally accessible drive bay and replaced with another drive without shutting down the computer. Such drive bays similarly require a precise alignment between the female connector found in the drive bay and the PCBA connector on the disc drive. Thus, it has become increasingly important to manufacture disc drives having PCBA connectors that are precisely aligned relative to the outer dimensions or "envelope" of the drive, regardless of the drive form factor or interface specification of the drive.

Disc drive manufacturers have previously utilized a number of different manufacturing techniques to properly position the PCBA connector relative to the remainder of the disc drive. These techniques include precise mating of the PCBA connector to the printed circuit board itself, as well as precise mounting of the PCBA to the base plate of the disc drive. For instance, alignment features on the PCBA are often used to mate with corresponding features on the drive base plate. Additionally, mounting holes formed in the PCBA are formed with very close tolerances to provide a tight fit between the mounting screws and the mounting holes formed in the PCBA. Thus, manufacturers have previously attempted to indirectly control the location of the PCBA connector relative to the disc drive envelope by using alignment features and tight manufacturing tolerances between the PCBA and the drive base plate. That is, manufacturers have previously attempted to meet the SFF Specification (i.e., control the location of the PCBA connector) by controlling the location of the PCBA relative to the base plate.

While such indirect control of the position of the PCBA connector has previously proven to be capable of meeting the SFF Specification, it is understood that there are manufacturing tolerances within each step of the disc drive assembly. Thus, there is a first

manufacturing tolerance when the connector is attached to the PCBA, and then a second manufacturing tolerance when the PCBA is fixed to the base plate of the disc drive. This tolerance "stack-up" can occasionally lead to disc drives having connectors that are misaligned according to the SFF Specification. Indeed, as noted above, a great deal of effort is placed on minimizing this tolerance stack-up by requiring the use of precision assembly techniques, such as the drilling of precision mounting holes in the PCBA. However, such precision techniques can increase the cost and the assembly time of a Small Form Factor disc drive.

Accordingly, there is a need for improving the accuracy of positioning a PCBA connector relative to a disc drive envelope while reducing the cost and time required to assemble such a disc drive. The present invention provides a solution to this and other problems, and offers other advantages over the prior art.

Summary of the Invention

The present relates to a disc drive having a printed circuit board assembly and an electrical connector that includes a locating feature for aligning the electrical connector relative to an outer dimension of the disc drive.

In accordance with one embodiment of the present invention, a disc drive includes a top cover, a base plate, and a printed circuit board attached to the base plate. The printed circuit board includes an electrical connector secured to an edge of the printed circuit board. A guide pin protrudes from one of the base plate and the electrical connector and is received within an opening defined in the other of the base plate and the electrical connector to position the electrical connector relative to the base plate. In a preferred embodiment, the opening comprises a slot defined in a bottom surface of the base plate and the guide pin protrudes from the electrical connector.

The bottom surface of the base plate may include a plurality of threaded openings that correspond with a plurality of oversized mounting holes formed in the printed circuit board so that threaded fasteners can be inserted through the oversized mounting holes and into the threaded openings to secure the printed circuit board to the base plate while the guide pin remains positioned within the opening.

The present invention can also be implemented as a method of positioning an electrical connector of a printed circuit board relative to a base plate of a disc drive, where the

method includes the step of inserting a guide pin formed on one of the electrical connector and the base plate into an opening formed in the other of the electrical connector and the base plate of the disc drive to align the electrical connector with the base plate. The method further includes the step of fastening the printed circuit board to the base plate of the disc drive while the guide pin remains within the opening.

The present invention can further be implemented as a disc drive having a base plate and a printed circuit board attached to the base plate. The disc drive includes an electrical connector attached to one end of the printed circuit board, and the connector includes a plurality of data pins adapted to mate with a female connector in a computer system. The disc drive also includes means for aligning the electrical connector relative to the base plate so that the data pins will be received within corresponding sockets of the female connector when the disc drive is installed within the computer system. In one preferred embodiment, the disc drive includes means for securing the printed circuit board to the base plate, and the securing means are separate from the means for aligning the electrical connector relative to the base plate.

These and various other features as well as advantages which characterize the present invention will be apparent from a reading of the following detailed description and a review of the associated drawings.

Brief Description of the Drawings

FIG. 1 is a perspective view of a disc drive incorporating an embodiment of the present invention, with a top cover of the disc drive partially broken away.

FIG. 2 is an exploded perspective view of the disc drive of FIG. 1 specifically illustrating a bottom surface of a base plate of the disc drive, a printed circuit board assembly (PCBA), and an electrical connector that is secured to the PCBA prior to the PCBA being fastened to the disc drive base plate.

FIG. 3 is a further exploded perspective view of the disc drive of FIG. 1 illustrating a guide pin on the PCBA electrical connector aligned above a slot formed in the base plate.

FIG. 4 is a perspective view of the assembled disc drive of FIG. 1 with a portion cut away to illustrate the guide pin on the PCBA electrical connector as the guide pin is inserted within the slot formed in the base plate.

FIG. 5 is a perspective view of the assembled disc drive of FIG. 1 similar to FIG. 4 illustrating the guide pin on the PCBA electrical connector fully inserted within the slot formed in the base plate.

FIG. 6 is a flow diagram illustrating a process of aligning the electrical connector and securing the PCBA to the base plate.

Detailed Description

A disc drive **100** constructed in accordance with a preferred embodiment of the present invention is shown in FIG. 1. The disc drive **100** includes a base plate **102** to which various components of the disc drive **100** are mounted. A top cover **104**, shown partially cut away, cooperates with the base **102** to form an internal, sealed environment for the disc drive in a conventional manner. The components include a spindle motor **106** which rotates one or more discs **108** at a constant high speed. Information is written to and read from tracks on the discs **108** through the use of an actuator assembly **110**, which rotates about a bearing shaft assembly **112** positioned adjacent the discs **108**. The actuator assembly **110** includes a plurality of actuator arms **114** which extend towards the discs **108**, with one or more flexures **116** extending from each of the actuator arms **114**. Mounted at the distal end of each of the flexures **116** is a head **118** which includes an air bearing slider enabling the head **118** to fly in close proximity above the corresponding surface of the associated disc **108**.

The radial position of the heads **118** is controlled through the use of a voice coil motor **124**, which typically includes a coil **126** attached to the actuator assembly **110**, as well as one or more permanent magnets and return plates **128** which are spaced apart to establish a vertical magnetic field within which the coil **126** is immersed. The controlled application of current to the coil **126** causes magnetic interaction between the permanent magnets **128** and the coil **126** so that the coil **126** moves in accordance with the well known Lorentz relationship. As the coil **126** moves, the actuator assembly **110** pivots about the bearing shaft assembly **112** and the heads **118** are caused to move across the surfaces of the discs **108**.

A flex assembly **130** provides the requisite electrical connection paths for the actuator assembly **110** while allowing pivotal movement of the actuator assembly **110** during operation. The flex assembly includes a printed circuit board **132** to which head wires (not shown) are connected; the head wires being routed along the actuator arms **114** and the flexures **116** to the heads **118**. The printed circuit board **132** typically includes circuitry for

controlling the write currents applied to the heads **118** during a write operation and for amplifying read signals generated by the heads **118** during a read operation. The flex assembly terminates at a flex bracket **134** for communication through the base plate **102** to a disc drive printed circuit board assembly ("PCBA") **200** (FIGS. 2 and 3) mounted to the bottom side of the disc drive base plate **102**.

Referring now to FIG. 2, a bottom surface **202** of the base plate **102** is shown exploded from the PCBA **200**. An electrical connector **204** is also shown exploded away from the PCBA **200**. The bottom surface **202** of the disc drive base plate **102** includes a plurality of mounting pedestals **206** having a flat or planar mounting surface for the disc drive **100**. Threaded holes **208** formed in each of the mounting pedestals **206** allow the disc drive **100** to be mounted either from below or from beside the disc drive **100**. The bottom surface **202** of the base plate **102** also includes a formed circular region **210** for receiving a bottom portion of the spindle motor **106**. A spindle motor connector **212** is attached at one end of the formed region **210** and includes a plurality of spring contacts **214** extending above or away from the bottom surface **202** of the base plate **102**.

As further shown in FIG. 2, a top surface **216** of the PCBA **200** includes a keyhole-shaped opening **218** and a plurality of metal pads or contacts **220** positioned adjacent a flat end of the keyhole-shaped opening **218**. The keyhole-shaped opening **218** allows the PCBA **200** to fit over the formed spindle motor region **210** of the base plate **102** and engage the spindle motor connector **212** when the PCBA **200** is secured to the bottom surface **202** of the base plate **102**. The opening **218** allows the metal pads **220** on the top surface **216** of the PCBA **200** to engage the spring contacts **214** of the spindle motor connector **212**. It is this contact between the pads **220** and the spring contacts **214** that supplies electrical power to the spindle motor **106**.

The electrical connector **204** (FIG. 2) preferably comprises a vertically oriented pin supporting wall **222** formed from an electrically insulating material such as plastic. Two laterally oriented attachment tabs **224** are positioned at opposite ends of the pin supporting wall **222**, and each tab **224** includes a downward protruding post (not shown) that corresponds with an opening **228** formed in the PCBA **200**. The pin supporting wall **222** holds a plurality of pins **230** extending from a front surface of the wall **222**. As the connector **204** shown in FIG. 2 comprises a 50-pin ATA connector, the pins **230** are a mixture of data

and power pins. However, while an exemplary 50-pin ATA connector is shown in FIGS. 1-5, it is understood that different connectors **204** embodying various interface specifications (and thus various numbers and arrangements of pins **230**) may be utilized with the present invention. A contact **232** corresponding to each pin **230** extends from a rear surface of the pin supporting wall **222**. Each contact **232** defines a contact surface for engaging a corresponding pad **234** positioned on the top surface **216** along an edge **236** of the PCBA **200**.

The connector **204** is attached to the PCBA **200** by first aligning the downward protruding posts (not shown) in the tabs **224** over the corresponding holes **228** in the PCBA **200** so that the contact surfaces of the contacts **232** engage the corresponding pads **234** on the PCBA **200**. The posts are then preferably soldered in place within the holes **228** to secure the connector **204** to the PCBA **200**. In some embodiments, the contacts **232** may be soldered to their corresponding pads **234** (such as through a reflow process) to ensure adequate electronic contact between the traces **232** and the pads **234**. Additionally, alternative means for securing the connector **204** to the PCBA **200** are readily known to those skilled in the art.

While each of the pins **230** performs a specific function as defined by the respective interface specification (e.g., the ATA specification), one of the pins (i.e., a "first pin" **240**) is typically designated for purposes of the Small Form Factor ("SFF") Specification. That is, the SFF Specification expressly recites the position of the first pin **240** relative to the outer envelope of the disc drive. In order to ensure the proper position of the first pin **240** relative to the outer dimensions of the disc drive **100**, the present invention utilizes alignment means positioned on the connector **204** itself as well as on the bottom surface **202** of the base plate **102**. These alignment means preferably comprise a guide pin formed on one of the connector **204** and the base plate **102**, and an opening formed on the other of the connector **204** and the base plate **102** to receive the guide pin. In the preferred embodiment of the invention shown in the drawing, the guide pin is formed on the connector **204** while the opening is formed on the base plate **102**, however it is understood that the position of these features could be reversed and that the present invention encompasses the placement of the guide pin on the base plate **102** and the formation of the opening in the connector **204**.

Specifically, FIG. 2 illustrates a guide pin **242** extending upward from a top surface of the pin supporting wall **222**. The guide pin **242** is preferably cylindrical in shape and

includes a chamfered tip **246** (FIGS. 4 and 5). The guide pin **242** is preferably formed from the same electrically insulating material used to form the connector **204** and, in a preferred embodiment, the guide pin **242** is molded together with the connector **204**. Forming the guide pin **242** as an integral molded feature of the connector **204** ensures accurate placement of the guide pin **242** relative to the first pin **240** of the connector **204**. Indeed, in one preferred embodiment of the present invention, the guide pin **242** is molded directly over the location of the first pin **240**.

FIGS. 2 and 3 illustrate that the bottom surface **202** of the base plate **102** includes an opening **250** formed therein for receiving the guide pin **242**. In one preferred embodiment, the opening **250** is formed as an elongated slot to ease insertion of the guide pin **242** within the opening **250**. However, the present invention encompasses different shapes (e.g., a round hole) for the opening **250** other than the elongated slot shown in the drawing.

In one embodiment, the base plate **102** includes a recessed region **252** for receiving the connector **204**, and the slot **250** is formed in an upper surface **254** of that recessed region **252**. The slot **250** is substantially cylindrical in shape and includes a chamfered end **256** (FIG. 4) for receiving the chamfered tip **246** of the guide pin **242**. Additionally, the slot **250** has a depth that is preferably slightly greater than a height of the guide pin **242** to ensure that the tip **246** of the pin **242** does not bottom out or contact the end **256** of the slot **250**. See FIGS. 4 and 5 which illustrate cut away views of the guide pin **242** being received within the slot **250**. In a preferred embodiment of the present invention, the slot **250** is formed as a cast feature of the cast aluminum base plate **102**, although the slot **250** may alternatively be machined into the cast base plate.

During assembly of the disc drive **100**, the guide pin **242** is inserted into the slot **250** to align the connector **204** (and specifically the first pin **240** of the connector) with the base plate **102** of the disc drive **100** prior to securing the PCBA **200** to the base plate **102**. The guide pin **242** fits snugly within the slot **250** to provide precise positioning of the connector **204** relative to the base plate **102**. Once the connector **204** has been properly positioned relative to the base plate **102**, mounting screws **258** are then inserted through mounting holes **260** formed in the PCBA **200** and into threaded openings **262** formed in the bottom surface **202** of the base plate **102**. The mounting screws **258** are then tightened down against the PCBA **200** while the guide pin **242** remains situated within the slot **250**. While a single guide

pin **242** is shown in FIGS. 1-3, it is understood that a second pin could be formed on the connector **204** to further aid in precisely positioning the connector **204** relative to the base plate **102**. For example, a second pin may be desirable to prevent the connector **204** from rotating relative to the base plate **102** about an axis through the first pin **242**. Thus, the present invention encompasses the use of one or more pins **242** mating with one or more openings **250**. Furthermore, as described above, the location of the pin **242** and the opening **250** may be reversed relative to the preferred embodiment shown in the drawing by casting the pin **242** on the base plate **102** and molding the opening **250** in the connector **204**.

The use of one or more guide pins **242** and a corresponding number of openings or slots **250** allows the position of the connector **204** to be determined relative to the base plate **102** (i.e., relative to the outer dimensions or "envelope" of the disc drive **100**) with a high degree of accuracy before the mounting screws **258** fix the PCBA **200** to the base plate **102**. Furthermore, because the mounting screws **258** and the mounting holes **260** are no longer used to establish the position of the connector **204** as in the prior art, the holes **260** can be formed in an "oversized" manner relative to the mounting screws **258** to prevent the screws **258** from binding against the sides of the oversized holes **260** during the mounting procedure. In the context of the present invention, the term "oversized" means that the size of the mounting hole **260** is sufficiently large to prevent contact between an edge of the hole **260** and a shaft of the mounting screw **258**, but yet the hole **260** is smaller than a head of the mounting screw **258**, thereby allowing the mounting screw **258** to effectively secure the PCBA **200** to the base plate **102** while not interfering with the fastening procedure. This represents an improvement over prior art SFF disc drives where the mounting hole in the PCBA is sized to closely match the diameter of the shaft of the mounting screw in order to precisely position the PCBA and thus the connector relative to the base plate of the disc drive. Where the mounting holes and screws are closely matched in size (as in the prior art), they tend to bind against one another thus increasing the time required to assemble the PCBA to the disc drive. The present invention thus provides an improvement in the manufacturing process of SFF disc drives.

As noted above, the use of the guide pin **242** and the opening or slot **250** provides for precise positioning of the connector **204** relative to the base plate **102**. By directly positioning the connector **204** relative to the base plate **102** (as opposed to first positioning

the connector **204** relative to the PCBA **200**, and then positioning the PCBA **200** relative to the base plate **102**), the present invention avoids the build up or "stacking" of tolerances that can reduce the positional accuracy of the PCBA connector. Additionally, because the pin **242** and the slot **250** are respectively molded or cast in place, the tolerances for both of these parts can be very tightly controlled during the molding or fabrication process.

As shown in FIGS. 3 and 4, the preferred embodiment of the guide pin **242** formed on the connector **204** is sufficiently long to allow the tip **246** of the pin **242** to be received within the slot **250** even before the PCBA **200** is compressed downward against the force of the spring contacts **214** on the spindle motor connector **212**. That is, during assembly of the PCBA **200** to the base plate **102**, the PCBA is initially suspended above the inverted base plate **102** by contact between the pads **220** on the PCBA **200** and the spring contacts **214** found on the spindle motor connector **212**. The subsequent attachment of the mounting screws **258** serves to screw the PCBA **200** down flush against the bottom surface **202** of the base plate **102** while simultaneously compressing the spring contacts **214** against the pads **220** to ensure good electrical contact with the pads **220**. During this process, the guide pin **242** remains in place within the slot **250** to control the positional accuracy of the connector **204** relative to the base plate **102**. Indeed, the length of the guide pin **242** allows the connector **204** to be initially aligned when the PCBA **200** is first laid on the bottom surface **202** of the base plate **102**, while the depth of the slot **250** allows the tip **246** of the guide pin **242** to move downward within the slot **250** as the mounting screws **258** secure the PCBA **200** to the base plate **102**. See FIGS. 4 and 5.

As noted above, the depth of the preferred opening or slot **250** is preferably slightly greater than the length of the guide pin **242** to prevent the tip **246** of the pin from contacting the bottom end **256** of the slot **250** when the pin **242** is fully received within the slot **250** (FIG. 5). In this manner, the interaction between the guide pin **242** and the slot **250** does not interfere with the flush mounting of the PCBA **200** on the bottom surface **202** of the base plate **102**.

In one preferred embodiment, the guide pin **242** may be positioned (i.e., molded) directly over the location of the first pin **240**, while the slot **250** is correspondingly located (i.e., cast) within the base plate **102** of the disc drive. As noted above, the SFF Specification particularly specifies the location of the first pin **240** relative to the outer dimensions of the

disc drive **100**, and thus the highest degree of positional accuracy can be expected to be obtained by establishing the position of the pin **242** relative to the first pin **240**. However, the present invention covers alternative positions for the pin **242** and the slot **250**; including placing the pin **242** at the middle of the connector **204** or at an end of the connector opposite the first pin **240**.

FIG. 6 illustrates a flow diagram of a preferred method of securing the PCBA **200** to the bottom surface **202** of the base plate **102** while ensuring that the connector **204** is properly positioned relative to the external disc drive dimensions pursuant to the SFF Specification. The method starts at step **602** where the PCBA **200** is aligned on the bottom surface **202** of the base plate **102** so that the pads **220** on the PCBA **200** loosely engage the spring contacts **214** on the spindle motor connector **212**. At this time, the oversized mounting holes **260** formed in the PCBA **200** are roughly positioned over the threaded openings **262** formed in the bottom surface **202** of the base plate **102**. In the next step **604**, the tip **246** of the guide pin **242** is inserted within the slot **250** to precisely align the connector **204** relative to the base plate **102**. As noted above, the pin **242** may be alternatively formed on the connector **204** or the base plate **102**, although in the preferred embodiment shown in FIGS. 1-5 the pin **242** is formed on the connector **204**. In one preferred embodiment, steps **602** and **604** may be combined together (i.e., the steps may be performed simultaneously) so that the oversized mounting holes **260** formed in the PCBA **200** are positioned over the threaded openings **262** formed in the base plate **102** at the same time that the guide pin **242** is received within the slot **250**. In the next step **606**, the mounting screws **258** are inserted through the mounting holes **260** and into the threaded openings **262** to tighten the PCBA **200** down against the bottom surface **202** of the base plate **102**.

As noted above, the use of a guide pin **242** and a slot **250** as positioning means that are separate and distinct from the mounting screws **258** and the mounting holes **260** allows the present invention to utilize relatively large or "oversized" mounting holes **260**. Thus, contrary to the prior art where close tolerances between the mounting screws and the mounting holes in the PCBA were necessary to properly align the PCBA connector, the present invention allows for a looser fit between the mounting screws **258** and the mounting holes **260** formed in the PCBA **200**. That is, because the guide pin **242** remains within the slot **250** during the tightening step **606** (see FIGS. 4 and 5), the mounting screws **258** are not

used to align the connector **204** but rather are only used to secure the PCBA **200** to the disc drive base plate **102**. This provides an improvement in the manufacturing process since less time is required to secure the mounting screws **258** through the oversized mounting holes **260** in the PCBA **200**.

While the present invention is illustrated with an exemplary 2.5 inch disc drive **100** having a 50 pin ATA connector, it is understood that the guide pin **242** or the opening **250** could be utilized with any type of connector (e.g., a SCSI or Serial ATA connector). Similarly, either the pin **242** or the corresponding opening **250** could be cast or machined into the base plate **102** of disc drives having varying sizes or "form factors" (e.g., a larger 3.5 inch drive or a smaller 1.8 inch drive). Furthermore, as noted above, it is understood that multiple pins **242** may be utilized in conjunction with multiple slots **250** in order to provide an even more precise positioning of the connector **204** relative to the base plate **102**. While it is believed that a single guide pin **242** is sufficient to meet the stringent positioning requirements of the SFF Specification, the present invention encompasses the use of additional pins **242** and openings or slots **250** to increase the positional accuracy of the connector **204**.

In summary, a disc drive (such as **100**) in accordance with an exemplary preferred embodiment of the present invention has a top cover (such as **104**), a base plate (such as **102**), and a printed circuit board (such as **200**) attached to the base plate (such as **102**). The printed circuit board (such as **200**) includes an electrical connector (such as **204**) secured to an edge of the printed circuit board. A guide pin (such as **242**) protrudes from one of the base plate (such as **102**) and the electrical connector (such as **204**), and the guide pin (such as **242**) is received within an opening (such as **250**) defined in the other of the base plate (such as **102**) and the electrical connector (such as **204**). The interaction between the guide pin (such as **242**) and the opening (such as **250**) positions the electrical connector (such as **204**) relative to the base plate (such as **102**). In one preferred embodiment, the opening (such as **250**) is defined in a bottom surface (such as **202**) of the base plate (such as **102**), and the guide pin (such as **242**) protrudes from the electrical connector (such as **204**).

The bottom surface (such as **202**) of the base plate (such as **102**) preferably includes a plurality of threaded openings (such as **262**), while the printed circuit board preferably includes a plurality of oversized mounting holes (such as **260**) that correspond to the threaded

openings (such as **262**) so that threaded fasteners (such as **258**) can be inserted through the mounting holes (such as **260**) and into the threaded openings (such as **258**) to secure the printed circuit board to the base plate (such as **102**).

In preferred embodiments of the invention, the base plate (such as **102**) is formed from cast aluminum while the opening (such as **250**) is formed as a cast feature of the base plate. The opening (such as **250**) may also be formed as a machined feature of the base plate (such as **102**). Additionally, the electrical connector (such as **204**) is formed from a molded plastic material and the guide pin (such as **242**) is formed as a molded feature of the connector (such as **204**).

Furthermore, in one preferred embodiment, the opening (such as **250**) comprises an elongated slot, and the guide pin (such as **242**) includes a chamfered tip (such as **246**). A predetermined length of the guide pin (such as **242**) is greater than a depth of the slot (such as **250**) to prevent the tip (such as **246**) of the guide pin (such as **242**) from contacting a bottom surface (such as **256**) of the slot (such as **250**). Where the bottom surface (such as **202**) of the base plate (such as **102**) includes a spindle motor electrical connector (such as **212**), and a top surface (such as **216**) of the printed circuit board (such as **200**) includes contact pads (such as **220**) for engaging the spindle motor connector (such as **212**), the length of the guide pin (such as **242**) is sufficient to allow the tip (such as **246**) to be received within the slot (such as **250**) while the printed circuit board is suspended by contact between the printed circuit board contact pads (such as **220**) and the spindle motor electrical connector (such as **212**). In one preferred embodiment, the guide pin (such as **242**) is positioned adjacent a predetermined data pin (such as **240**) extending from the electrical connector (such as **204**). In an alternative embodiment, the base plate (such as **102**) includes a plurality of openings (such as **250**) and the connector (such as **204**) includes a plurality of guide pins (such as **242**) to provide additional precision in aligning the connector (such as **204**) relative to the base plate (such as **102**).

In another exemplary preferred embodiment of the present invention, a method of positioning an electrical connector (such as **204**) of a printed circuit board (such as **200**) relative to a base plate (such as **102**) of a disc drive (such as **100**) includes the step (such as **604**) of inserting a guide pin (such as **242**) formed on one of the electrical connector (such as **204**) and the base plate (such as **102**) into an opening (such as **250**) formed in the other of the

electrical connector (such as **204**) and the base plate (such as **102**) of the disc drive to align the electrical connector (such as **204**) with the base plate (such as **102**). The method further includes the step (such as **606**) of fastening the printed circuit board (such as **200**) to the base plate (such as **102**) of the disc drive (such as **100**) while the guide pin (such as **242**) remains within the opening (such as **250**).

In yet a further exemplary preferred embodiment of the present invention, a disc drive (such as **100**) includes a base plate (such as **102**) and a printed circuit board (such as **200**) attached to the base plate (such as **102**). The disc drive (such as **100**) includes an electrical connector (such as **204**) attached to one end of the printed circuit board (such as **200**), and the connector (such as **204**) includes a plurality of data pins (such as **230**) adapted to mate with a female connector in a computer system. The disc drive (such as **100**) also includes means (such as **242** and **250**) for aligning the electrical connector (such as **204**) relative to the base plate (such as **102**) so that the data pins (such as **230**) will be received within corresponding sockets of the female connector when the disc drive (such as **100**) is installed within the computer system. In one preferred embodiment, the disc drive (such as **100**) includes means (such as **258, 260** and **262**) for securing the printed circuit board (such as **200**) to the base plate (such as **102**), and the securing means (such as **258, 260** and **262**) are separate from the means (such as **242** and **250**) for aligning the electrical connector (such as **204**) relative to the base plate (such as **102**).

It will be clear that the present invention is well adapted to attain the ends and advantages mentioned as well as those inherent therein. While a presently preferred embodiment has been described for purposes of this disclosure, numerous changes may be made which will readily suggest themselves to those skilled in the art. For example, while the guide pin **242** is described as being molded to the connector **204**, it is understood that the pin **242** could also be attached to the connector **204** by other means (such as by adhesives or welding). Additionally, while the guide pin **242** is described as having a cylindrical shape with a chamfered end **246**, it is understood that guide pins of varying shape may be used in accordance with the present invention provided that the pin fits snugly within a corresponding opening or receptacle **250** to provide a highly precise alignment between the connector **204** and the base plate **102** of the disc drive. Accordingly, all such modifications, changes and

alternatives are encompassed in the spirit of the invention disclosed and as defined in the appended claims.